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Itemized Cost of
Mill Building Construction

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ITEMIZED COST
OF
MILL BUILDING CONSTRUCTION

BY
MANUEL JOSEPH JACOBS

THESIS

FOR
DEGREE OF BACHELOR OF SCIENCE
IN
CIVIL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS

PRESENTED JUNE 1905

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U N I V E R S I T Y O F I L L I N O I S

May 22, 1905

This is to certify that the thesis prepared under the
immediate supervision of Instructor C. W. Malcolm by

MANUEL JOSEPH JACOBS

entitled ITEMIZED COST OF MILL BUILDING CONSTRUCTION

is approved by me as fulfilling this part of the requirements
for the degree of Bachelor of Science in Civil Engineering

Ira O. Baker.

Head of Department of Civil Engineering



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INTRODUCTION.

This thesis is intended to provide the engineer, as well as the contractor, with some practical methods of executing the work of construction of mill buildings and to provide him also with some reasonably accurate data on costs. No attention will be given to the design, nor to the computation of the various parts of a building except where such steps are necessary for explaining the construction, cost, etc. It will, perhaps, be worth mentioning that much of the information regarding the design, can be obtained from the following books:

- (1) Theory and Practice of Modern Framed Structures,
by Johnson, Bryan & Turneaure.
- (2) Architectural Engineering,
by Freitag.
- (3) Steel Mill Building,
by Prof. M. S. Ketchum.

When a contract for a building is to be taken, it is best for the contractor to visit the place of erection, before the estimates are made and the bids are submitted, and to examine the site, keeping in mind the following points:

- (1) Its location with reference to the nearest railroad station or track.
- (2) The available area for unloading and for storing the building material.
- (3) The chances of getting skilled and unskilled labor.
- (4) The cost of labor in that particular locality.

The importance of the above points will be taken up in order.

1. If the material is to be loaded into wagons and hauled from the railroad to the place of erection, the additional cost incurred will be an important item to be included in the bid.

2. If the material has to be handled more than once before it is put into the building proper, then an additional cost will be incurred.

3. If laborers are to be imported from other cities, then transportation and perhaps board is to be added.

4. The price of common labor depends upon the locality, upon the different enterprises going on at the time, and also upon the condition of labor, i.e. whether organized or not.

These principles will be illustrated by special reference to a mill-building located at Lockland Ohio, and built by The James Stewart & Co., for the Philip Carey Mfg. Co., for the manufacture of roofing. It might be mentioned that the foundation was of concrete, and that the contract for it was sub-let; therefore the description of this particular building will deal chiefly with the superstructure. While this thesis is concerned chiefly with a mill building, it is nevertheless true that the general outline and data will be applicable to all classes of construction.

The cost of the work was materially affected by the following conditions. The C. H. & D. R. R. has a track in the Philip Carey yards, so that the lumber could be unloaded by laborers with a haul of not more than 150 feet, but as there was not enough available area, much of the material had to be handled a number of times before it reached its final position on the building. Owing to the great number of buildings that were being erected in the various parts of Cincinnati, during the summer of 1904, bricklayers were at a premium, and in order to get the building completed in reasonable time it was found necessary to import bricklayers from other cities, to pay their transportation, and to give them 62 1/2c per hour.

With these conditions in view, it will be the purpose of the writer to explain the progress of the work during the various stages, and from data gathered by the writer on the job to discuss the cost of the following items:

- (1) Cost of Equipment.
- (2) " " Unloading Lumber Cars.
- (3) " " Saw Mill Work.
- (4) " " Framing Dimension Timber.
- (5) " " Erecting " "
- (6) " " Mill Work.
- (7) " " Carrying Floor.
- (8) " " Steel and Cast Iron Work.
- (9) " " Brick Wheelers, Unloading Cars.
- (10) " " Hod Carriers and Mortar Men.
- (11) " " Bricklayers per 1000 brick laid.
- (12) " " Administration.

It is also the intention of the writer to illustrate the method of computing the different lumber lists for the saw mill, the working out of the pay roll, and the cost and insurance reports.

When the contract was awarded, lists for the various materials were made out by the contractor, and orders sent in for the material. The writer submits the following specifications for quality and quantity of the lumber required for the job to illustrate the nature of the various bills of material.

SPECIFICATION FOR LUMBER.

Specifications and Bill of Lumber required for the Philip Carey Manufacturing Co's. Roofing Factory in course of erection at Lockland, Ohio.

SHIPPING INSTRUCTIONS.

All material to be shipped to _____, care of Philip Carey Mfg. Co. Lockland, Ohio.

FRAMING LUMBER.

All of the dimensioned lumber to be of what is known as square edge and sound long-leaf yellow pine, to be manufactured from sound stock, free from large, loose and unsound knots, wane sake, or other defects which will affect its strength and durability.

All dimensions given are in the rough, and where specified to be dressed, 1/4" will be allowed for dressing: namely; a 12" x 12" stick when surfaced on four sides (S4S) to work to 11 3/4"x11 3/4". Where columns are specified to be bored, a 1 1/2" hole should be bored the entire length of the column, through the center.

CARRYING FLOOR.

All flooring in Lot No. 5 to be thoroughly seasoned. It shall be sound, long yellow leaf pine, and shall be free from splits and sake, loose and unsound knots, and wane and other defects which will impair its strength and durability. It shall be laid without cull or waste, and shall be butted.

This material is to be Marked and Beaded (M&B) 1S and to work when finished to 2 3/4" in thickness to 5 1/4" face.

ROOF SHEATHING.

All lumber in lot No. 6 (see page 6) to be of the same grade of flooring as lot No. 5. It shall be made from 2"x6" stock, Marked and Beaded, and when finished shall work to 1 5/8" by 5 1/4" face.

All lumber to be shipped in the order as follows:

1st-All lumber in lot #1 and 30 % of flooring in lot #5.

2d - " " " " 2 " 30 % " " " " #5.

3rd- " " " " 3 " balance of lot #5 and 50 % of sheathing in lot #6.

4th-All lumber in lot #4 and balance to complete entire bill.

FIRST STORY, LOT NO. 1.

8 Pcs.	11x11x10'0"	S4S & Bored	807 ft.	\$22.00 M
35 "	12x12x10'0"	" "	4200 "	22.00 "
10 "	13x13x10'0"	" "	1409 "	23.00 "
19 "	14x14x10'0"	" "	3103 "	23.00 "
6 "	12x16x10'0"	" "	960 "	22.00 "
17 "	12x16x14'0"	" "	3808 "	22.00 "
35 "	12x16x16'0"	" "	8960 "	22.00 "
17 "	12x16x16'4"	" "	4624 "	22.00 "
14 "	16x18x22'0"	" "	7392 "	24.00 "
198 "	8x14x16'0"	" "	29568 "	20.50 "
12 "	8x14x20'0"	" "	2240 "	20.50 "
42 "	6x14x16'0"	" "	4704 "	20.50 "
3 "	6x14x20'0"	" "	420 "	20.50 "
			<hr/> 72195	

SECOND STORY LOT NO.2.

34 Pcs.	10x10x14'0"	S4S & Bored	3967 ft.	\$21.50 "
15 "	11x11x14'0"	" "	2118 "	22.00 "
10 "	12x12x14'0"	" "	1680 "	22.00 "
13 "	13x13x14'0"	" "	2563 "	23.00 "
8 "	12x16x14'0"	" "	1920 ft.	22.00 "
8 "	12x16x16'0"	" "	2048 "	22.00 "
8 "	12x16x16'0"	" "	2176 "	22.00 "

5.

8 Pcs.	12x16x18'0"	S4S & Bored	2304 ft.	\$22.00 M
20 "	14x18x16'0"	" "	6720 "	23.00 "
4 "	14x18x18'0"	" "	1512 "	23.00 "
4 "	14x18x20'0"	" "	1680 "	23.00 "
8 "	16x18x20'4"	" "	4032 "	23.00 "
3 "	16x20x14'4"	" "	1200 "	24.00 "
3 "	16x20x16'0"	" "	1280 "	24.00 "
3 "	16x16x20'4"	" "	1360 "	24.00 "
4 "	16x20x18'0"	" "	1920 "	24.00 "
5 "	16x20x20'4"	" "	2800 "	25.00 "
38 "	6x14x16'0"	" "	4256 "	20.50 "
4 "	6x14x18'0"	" "	504 "	20.50 "
2 "	6x16x18'0"	" "	256 "	22.00 "
6 "	6x16x18'0"	" "	864 "	22.00 "
2 "	6x16x22'0"	" "	352 "	23.00 "
178 "	8x14x16'0"	" "	26581 "	20.50 "
2 "	10x16x12'0"	" "	320 "	22.00 "
15 "	10x17x15'0"	" "	3000 "	22.00 "
28 "	10x16x17'0"	" "	6346 "	22.00 "
17 "	10x16x18'0"	" "	4080 "	22.00 "
16 "	12x16x21'0"	" "	5376 "	23.00 "
			<u>93215</u>	

THIRD FLOOR, LOT NO.3.

12 Pcs.	10x10x14'0"	S4S & Bored	1400 ft.	Per M \$21.50
4 "	12x12x14'0"	" "	672 "	22.00

FOURTH FLOOR, LOT NO. 4.

3 "	8x8x12'0"	S4S & Bored	192 ft.	19.00
6 "	8x8x13'0"	" "	416 "	19.00
3 "	8x8x14'0"	" "	224 "	19.00
2 "	8x12x16'0"	" "	256 "	19.50
8 "	8x12x16'0"	" "	1024 "	19.50
5 "	8x12x20'0"	" "	800 "	19.50
4 "	8x12x31'0"	" "	992 "	22.50
2 "	6x12x16'0"	" "	196 "	19.50
2 "	6x12x17'0"	" "	204 "	19.50
6 "	6x12x18'0"	" "	648 "	19.50
2 "	7x14x22'0"	" "	360 "	21.50
10 ""	8x12x16'0"	" "	1280 "	19.50
10 ""	8x12x17'0"	" "	1360 "	19.50
20 "	8x12x18'0"	" "	2880 "	19.50
10 "	8x14x22'0"	" "	2093 "	21.50
			<u>12925</u>	

CARRYING FLOOR, LOT NO. 5.

85 M ft.	3x6x14'0"	flooring M & B	SIS to 2 3/4x5 3/4
70 " "	" x16'0"	" "	" "
25 " "	" x20'0"	" "	" "
<u>180000</u>	All in this lot at \$17.00 per M.		

SUNDRIES, LOT NO. 6.

All of this lumber same as foregoing.

				Per M
45 Pcs.	2x6x16'0"	84S	720 ft.	\$14.75
10 "	2x6x13'0"	"	180 "	15.25
20 "	3x6x20'0"	"	600 "	17.50
75 "	2x8x16'0"	"	1600 "	15.25
100 "	2x6x16'0"	"	1600 "	14.75
15 "	2x4x18'0"	"	180 "	16.25
30 "	4x4x12'0"	"	480 "	19.00
3 "	4x6x16'0"	"	96 "	19.00
	7/8x5 1/4 D&M No.1Com.Flooring		2500 "	16.75

A short time before the material was due to arrive at the site, a Superintendent was sent to the place, with the necessary tools for the construction of the building. The writer submits the tool list sent from headquarters.

LIST OF TOOLS FOR THE LUMBER PART.

1 hoisting engine complete.
 1 sawmill.
 1 sawmill outfit.
 500 ft. 3/4" & 7/8 wire cables.
 6 cross cut saws with handles.
 3, 3lb. sledge hammers.
 6 crow bars.
 5 crack bars.
 10 8" single blocks.
 10 8" double "
 2 oil cans.
 800 ft. 3/4" & 1 1/4" Manilla rope.
 250 " 1 1/2"
 1 lot old rope for slings.
 6 iron double blocks.
 6 " single "
 6 " snatch "
 24 shovels.
 6 picks with handles.
 9 cant hooks.
 14 carrying hooks.
 2 axes.
 6 lumber dollies.
 6 wheel-barrows.
 4 lanterns.
 1 tool box.
 200 ft. rubber hose.
 3 hand boring machines.
 11 ship augurs.
 2 pulleys 2 7/16 bore 16" diameter with 10" face for sawmill.
 1 shaft 2 7/16 " x 19'8" long for sawmill.
 20 auger bits 3/4 to 2 1/2".
 20 lb. rainbow packing.
 2 "A" derricks 13 & 24 ft. long complete.
 25 lb. 3/4" cut washers.

- 1 8" taper file.
- 1 6" " "
- 1 8" smooth "
- 2 8" mill "
- 2 pad locks & keys.
- 2 saw handles.
- 2 axes.

ORGANIZATION.

The superintendent is the responsible party on the work. It is his duty to organize the various labor forces and direct the employes in such a way as to accomplish the best results at the lowest cost. One way to do this is to divide the labor into classes, and place each class in charge of a foreman. It is the duty of each foreman to direct his force and he is responsible for the work done by them. The superintendent is generally accompanied by a labor foreman, who takes charge of the laborers employed for the unloading of the material from the cars.

The labor foreman is to see that the unloading is done expeditiously, to check the bill of material, and to examine the quality of the goods. An intelligent foreman will unload the materials as near as possible to their final location in the building. This of course depends largely upon how the shipments are made and upon the available space at the site of construction. While the labor foreman with his men are unloading cars of material, the superintendent directs a force of carpenters to build an office room, tool sheds, and water-closets. If by this time the tools arrive, the labor foreman is instructed to detail a labor force to unload these tools, check, and place them in a shed so as to be readily accessible. While this work is in progress, the superintendent directs a machinist and a helper to put the hoisting machinery, such as engines and boilers, in position, and in some cases a saw mill. A couple of riggers are detailed to put the

derricks in position and fix up a few gin poles, etc. After the superintendent has all the arrangements well under control, he begins to make detailed arrangements for the future needs of the construction. For example, he can begin to compute the net lengths of posts, girders and floor beams so that by the time the saw mill is erected, the man in charge of the same can begin cutting the timber without further delay.

Fig. 1 shows a section through bays 4-5 to 12-13.

To get the net height of the posts the procedure is as follows: The height of the floor is 13'0" as shown in figure, but the height of the post will be 13'0" minus

the thickness of	7/8"	maple floor
"	"	" 2 3/4 " 6. & g. yellow pine floor.
"	"	" 14" floor timber.
"	"	" 18" girder.
"	"	" 1" cap.
		<hr/> 36 5/8" = 3' 5/8"

and $(13'-0") - (3'-0 \frac{5}{8"}) = 9'-11 \frac{3}{8}" =$ the net height of the post.

This list is made out and tabulated in the form shown on page 11 ^{and} gives the marks to be placed upon the several pieces.

All posts in the basement are marked A, and the second number indicates the number of the bay (see Fig.2, page 10), and the third the number of the post in the bay. Thus A--19--2 means the second post in the 19th bay of the basement.

Fig. 1

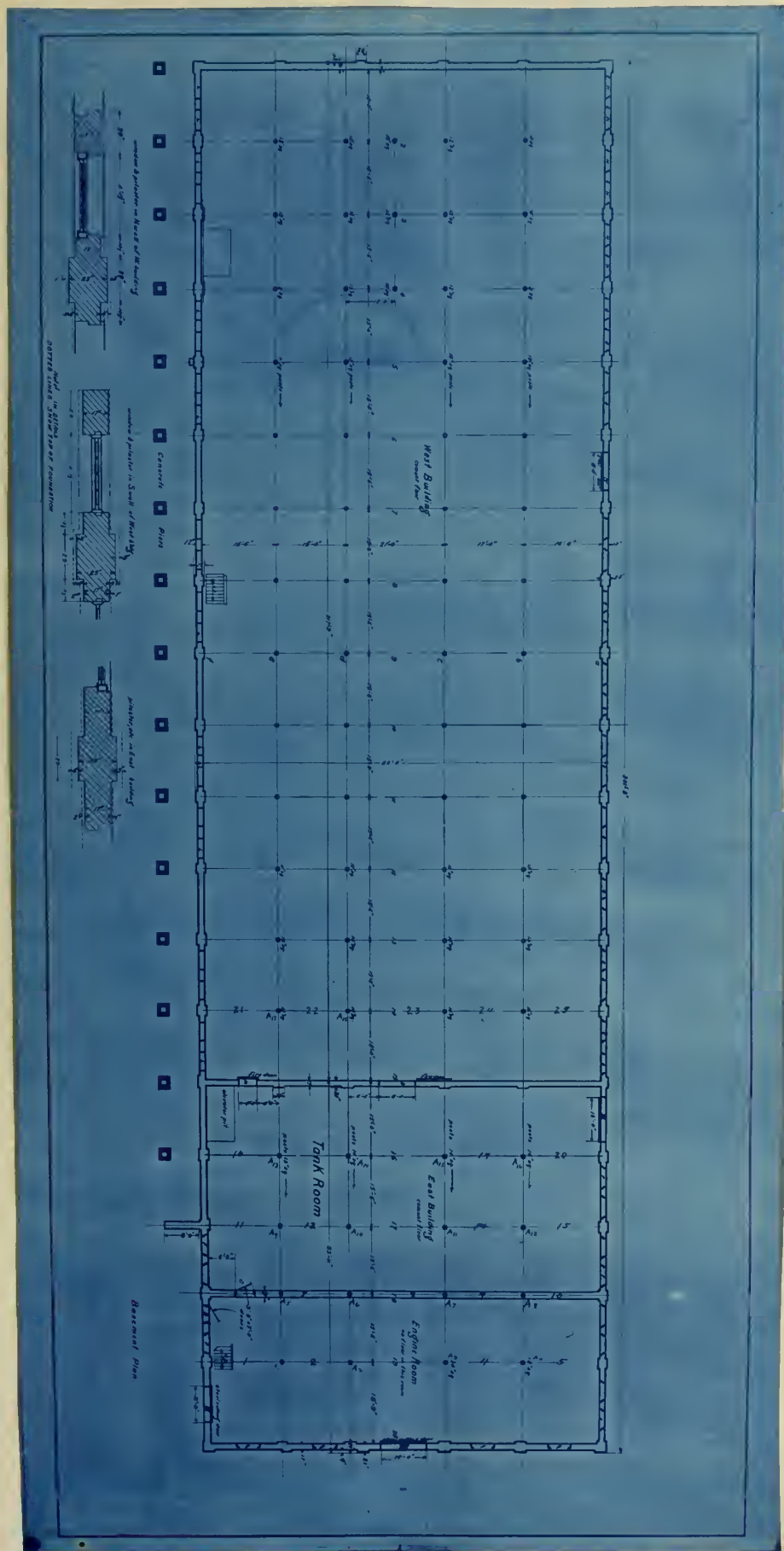


Fig. 2.

Saw Mill List

POSTS

N ^o of Pieces	Size	Length	Floor	Initial	Bay	Number.
4	13x13	10'-0 $\frac{7}{8}$ "	Basem.	A	16-17-18-19	1-5-9-13
8	14x14	9'-10 $\frac{5}{8}$ "	"	"	"	2-6-10-14-3-7-11-15
4	12x12	13'-7"	First	B	"	1-5-9-13
8	13x13	13'-9"	"	"	"	2-6-10-14-3-7-11-15

GIRDERS

	N ^o of Pieces	Size	Length	Ini.	Bay	N ^o	Bay	N ^o	Bay	N ^o	Bay	N ^o	Bay	N ^o	
Wall	10	12x16	15'-8"	B	14	21	13	26	12	31	11	36	10	41	
	2	"	14'-1"	"	"	22	"	27							
Wall	1	14x18	18'-11"	C	19	1									
	1	12x18	14'-7"	"	18	2									

FLOOR BEAMS

	N ^o of Pieces	Size	Length	Floor
	11	8x14	19'-4"	First
Wall	2	6x16	17'-0"	Second

Wall, indicates batter

"A" " Basement

"B" " First floor

"C" " Second "

THE MATERIAL ACCOUNT.

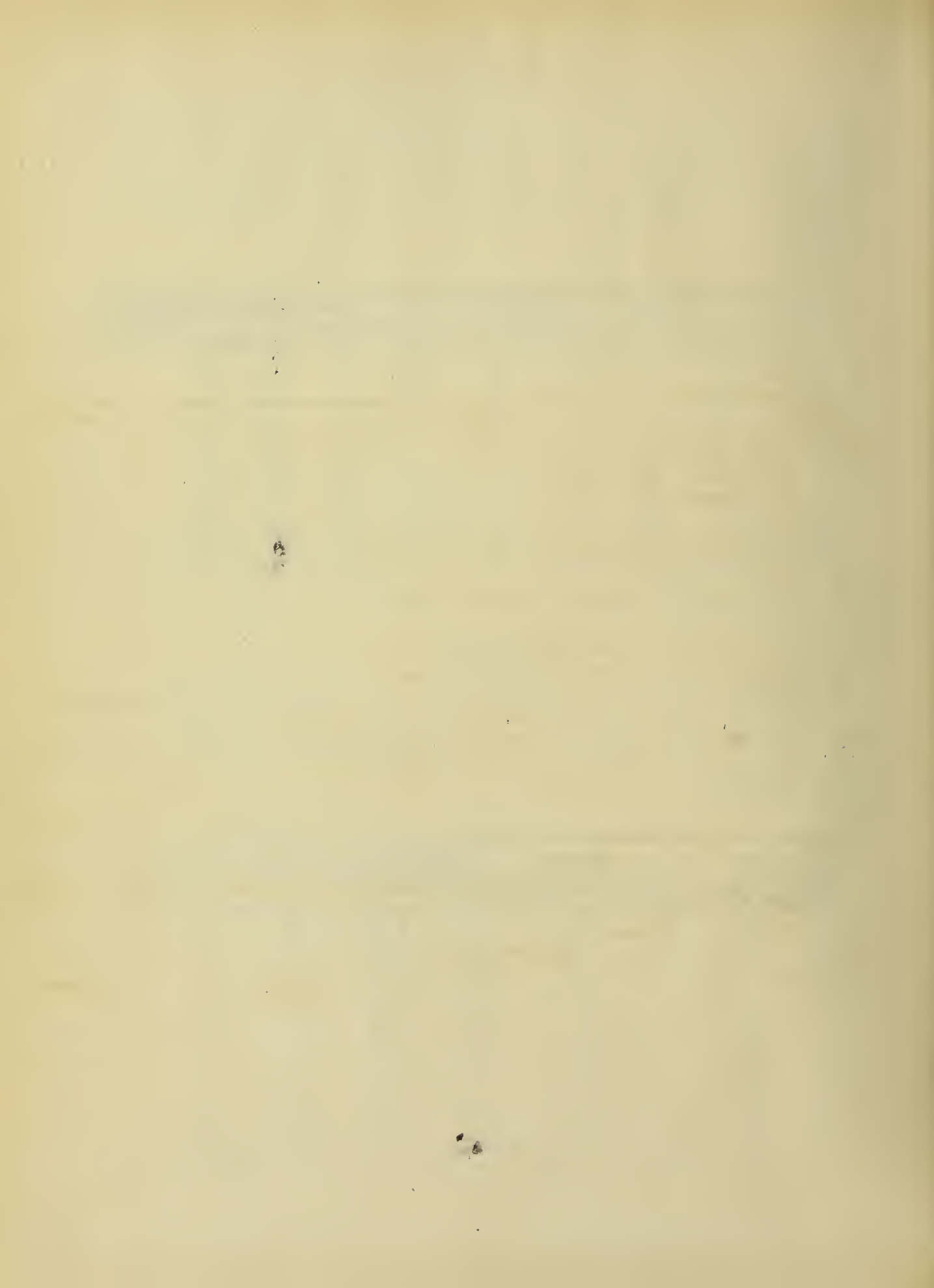
It is good practice to keep a material account in substantially the form shown below. This account is important for the reason that it gives, in a compact form, all the material as it arrives.

[illegible]

CAR RECORD.

The car record is also important for it may be used to check the cars when they arrive and are unloaded, and thus extra charges may be avoided.

[illegible]



THE EQUIPMENT ACCOUNT.

This account includes all costs for erecting sheds, closets, hoisting engines and saw-mill. It also includes the erection of scaffolds, the making of mortar boards, etc.

The table below includes the bulk of the equipment, the remainder of which will consist mostly of light scaffolding. It is therefore the opinion of the writer, that the additional cost of equipment will be very slight.

Date		Kind of Work done	Daily Cost	Weekly Cost
July	13	Grading for tool shed, and office, cleaning up old timbers	5 65	
"	14	Building tool shed.	9 10	14 65
"	20	Unloading Car of tools	18 00	
"	21	" " " "	16 00	34 00
"	22	Getting tools in place. in store house	8 50	
"	23	" " " " " " " "	6 00	
"	25	Engineer and helpers fixing up hoisting Engine	14 25	
"	26	" " " " " " " "	5 75	
"	26	Riggers and carpenters fixing derricks	14 25	
"	27	Engineer " Laborers " Saw mill	8 75	
"	28	" " " " " "	8 15	66 15
"	29	" " " Connecting " and Engine	21 80	
Aug.	1	Sawyer " " hoisting shaft	18 75	40 55
"	5	" " " engineer, and riggers making steam con	17 70	
"	8	Stiff leg derricks	21 70	
"	9	" " " "	3 20	42 60
"	12	Gin pole and Tee	3 00	
"	15	Putting up new saw	5 25	
"	17	Saws and cant hooks sharpened, trestles and Scaffolds	13 25	21 50
"	22	Mortar boxes and horses	24 71	24 71
"	31	" boards " "	2 00	
Sep.	1	" " " Scaffolding	4 00	6 00
Total				\$250 26

The total cost of equipment is \$250.26, the cost of the building is \$50,000.00. Then, the equipment amounts to $\frac{250}{50000} = 1/2\%$ of the cost. The writer is of the opinion that 1% is a fair average for equipment.

Riggers received from 20 to 40 cts. per hour; laborers, 17 1/2c per hour.

UNLOADING CARS.

Let N = the number of thousand feet of lumber unloaded per day.

Let C = the cost of labor per day.

Then $\frac{C}{N}$ = the cost of unloading 1000 ft. of lumber.

The table below shows the method of keeping the record, and gives fair average cost.

Date	Material Unloaded	Car		Quantity Unloaded in feet.	Daily Cost	Average Cost per 1000 ft.	Total Weekly Cost.	
		Number	Initial					
July	15	Lumber		9468	8.75	92		
"	16	"		77701	16.45	73		
"	18	"		21024	11.25	53		
"	19	"		17169	14.25	83		
"	21	"		10360	10.85	104	61	55
"	22	"		18178	17.50	96		
"	23	"		9292	14.50	156		
"	25	"		11109	13.10	118		
"	26	"		21099	18.95	90		
"	27	"		54835	32.80	50		
"	28	"		20448	9.25	45	106	10
Aug.	2	"		38561	10.85	29		
"	3	"		18596	7.95	43		
"	4	"		19202	6.12	32	24	92
Total				302022 ft.	Total		\$192	57

Hence the cost to unload lumber is $\frac{192.57}{3020.22} = 63c$ per 1000 ft., which is a fair cost. Laborers were paid at 17 1/2c per hour, and the labor foreman received \$60.00 per month.

THE SAW MILL.

The Mill was in charge of a sawyer and two helpers. When large timbers were to be handled more help was given, but when flooring were cut, the sawyer had only one helper.

Let K = the timber cut per day (board measure) in thousand feet.

Let C = the number of dollars paid out.

Then $\frac{C}{K}$ = the cost of cutting 1000 ft. at the mill.

To illustrate how the accounts were kept and to give an approximate idea of the cost, the writer has selected the following data:

Date		Description of work.	N ^o of feet Cut.	Daily Cost		Average Cost per 1000 feet	Total Weekly Cost.	
Aug.	2	Sawing dimension timber	11480	15	50	1	35	
	3	" " "	4760	10	50	2	21	
	4	" " "	24900	19	00	76		45 00
	6	" " "	37120	20	50	55		
	9	" " "	8375	6	50	77		
	10	" flooring	1050	1	75	166		28 75
	12	" "	9450	10	30	109		
	13	" "	9648	9	05	93		
	15	" girders	5670	5	50	97		
	16	" "	19990	6	55	33		31 40
		Total	132443					\$105 16

Dividing the total cost by the total number of thousand feet cut, we will get the cost per thousand or $\frac{105.15}{132443} = 79$ cts. The sawyer was paid \$25.00 per week and laborers, 17 1/2 cts. per hour.

FRAMING DIMENSION TIMBER.

This account consists of the chamfering of posts, girders, floor beams, and the cutting-in of stairways, elevator, shafts, etc. Carpenters were paid 35 cts. per hour; laborers, 17 1/2 cts. per hour. Carpenter foreman received \$100.00 per month.

Date		Description of the Work.	Total Work done in feet.	Daily Cost	Weekly Cost.	
Aug.	1	Carpenters and laborers Chamfering		9 40		
"	2	" " Timber		6 20		
"	3	" " "		6 00		
"	4	" " "		8 00		
"	5	" " "		8 00		
"	10	" framing "		8 25	45	85
"	11	" " "		4 60		
"	12	" " "		6 20		
"	13	" " "		6 00		
"	15	" " "		12 20	29	00
"	16	" " "		5 50		
"	17	" " "		8 00		
"	19	" " "		8 00		
"	20	" " "		16 75		
"	21	" " "		12 00	50	25
		Total	165410		\$125	10

Therefore the cost of chamfering timber is $\frac{\$125.10}{165410} = 74$ cts.
per 1000 ft. of timber.

ERECTING DIMENSION TIMBER.

It is the aim of the writer to show under this heading the cost of labor for placing the heavy timbers such as posts, girders, and floor beams. Riggers were paid 20 cts. per hour; rigger foreman, 40 cts. per hour.

Date		Description of Work.	Total Work done in feet.	Daily Cost	Total Weekly Cost.
Aug.	1	Rigging gang snatching posts into place.		6 00	
"	2	" " " "		5 50	
"	3	" " " "		5 00	
"	4	" " " "		10 00	
"	5	" " " "		12 20	
"	6	" " girders "		2 53	41 23
"	8	" " " "		6 00	
"	9	" " " "		10 35	
"	10	" " " "		1 15	
"	11	" " floor beams "		3 50	
"	12	" " " "		15 85	36 85
		Total	78890		\$78 08

The cost of placing heavy timbers after they had been cut and chamfered by the carpenters was $\frac{\$78.08}{78890} = \1.00 per thousand feet of lumber board measure.

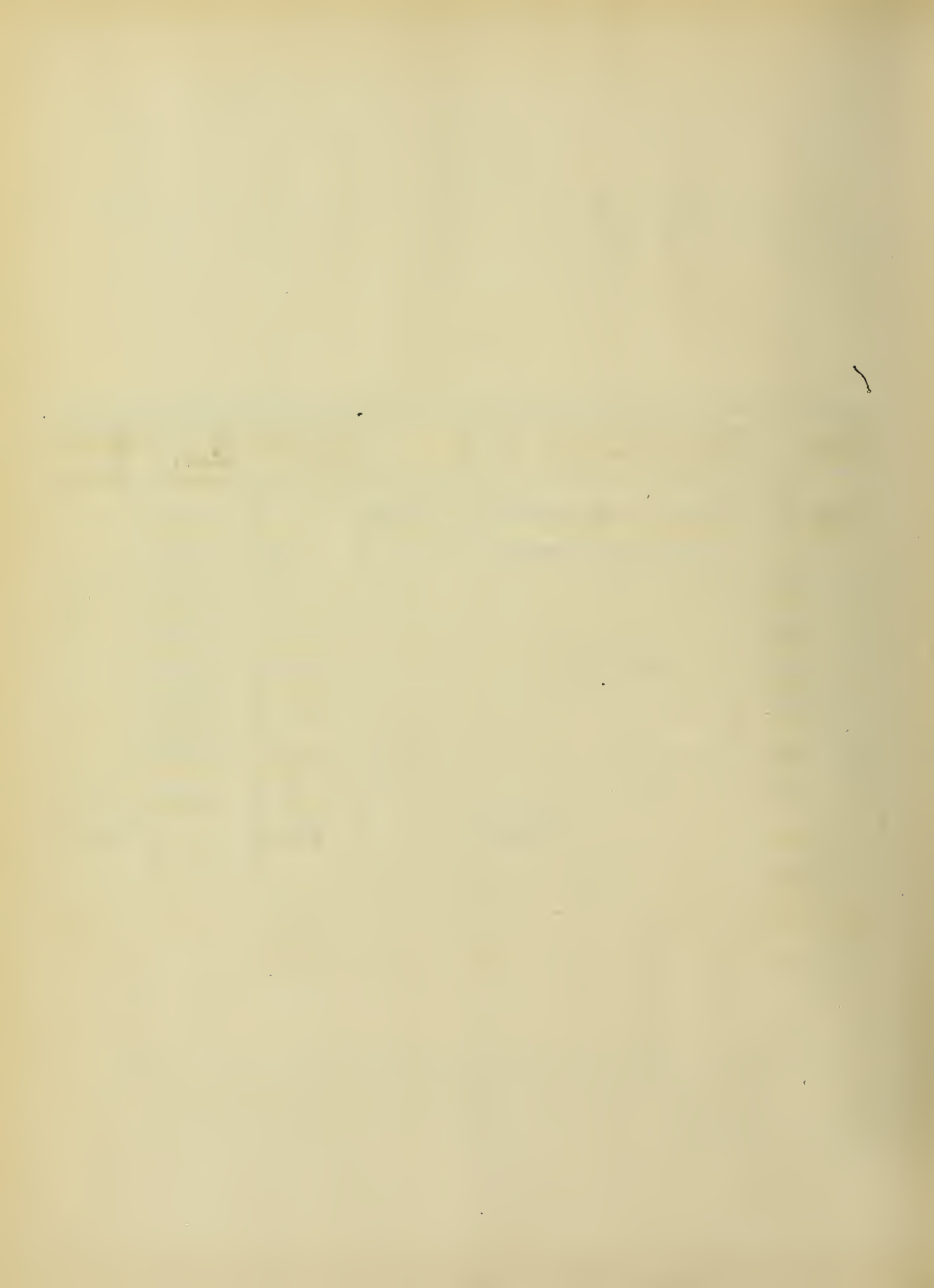
MILL WORK.

By this account is meant the cost of putting up the frames which come from the mill, such as windows, door-sills, etc.

Date		Description of Work	Frames Set.	Daily Cost		Weekly Cost	
Aug.	16	Carpenters and laborers setting					
"		basement window frames	29	21	75		
"	17	" "	19	11	50	32	25
"	23	" "	5	3	00	3	00
"	30	First floor "	10	8	00		
"	31	" "	13	10	40		
Sep.	1	" "	16	12	00		
"	2	" "	6	3	00	33	40
		Total	98			\$ 68	65

From these figures the writer concludes that the cost of labor on each window sill, in place, to the contractor was

$$\frac{68.65}{98} = 70 \text{ cents.}$$



CARRYING FLOOR.

Under this heading is considered the cost of laying the 3"x6"x12' or 14' tongued and grooved yellow pine flooring. From the data collected, it is the opinion of the writer that this is a fair average cost of labor per thousand feet of timber.

Date		Description of Work	Floor laid in feet	Daily Cost		Weekly Cost.	
Aug.	12	Laying floor	10500	12	00		
	13	" "	2000	3	00		
	15	" "	500	2	50	17	50
	22	" "	3100	9	00		
	23	" "	3160	10	00		
	25	" "	4665	12	00	31	00
	27	" "	5535	15	00		
	29	" "	11397	20	00		
	30	" "	9831	16	00		
	31	" "	4974	8	00		
Sep.	1	" "	9671	20	00	79	00
		Total	65333			\$127	50

The cost of labor for laying the floor was $\frac{12750}{65333} = 19$ cts.
per 1000 ft.

CAST IRON AND STEEL WORK.

Under this heading the writer intends to show the cost of labor per ton to unload, lay and place the castings and steel work.

Date		Description of Work.	Quantity Placed in pounds.	Daily Cost		Weekly Cost.	
Aug	9	Unloading castings & Setting plates		3	50		
"	10	" " "		2	430		
"	11	" " "	35136	11	00	38	80
"	26	" " placing caps		15	93		
"	27	" " "		15	00		
"	28	" " "	40254	17	00	54	93
"	31	" " "		7	00		
		Total	75490			\$93	73

The total amount of iron handled to fix this building was 75490 lbs. or 37.745 tons. The total is cost of labor was \$93.73
 or $\frac{93.73}{37.75} = \$2.43$ per ton.

At this point it might be well to state something regarding the brickwork. The contract for this work was sublet but the contractor forfeited his contract as he was loosing money. The Stewart Company was compelled to finish the work, and it is the intention of the writer to give a description of the organization and the progress of the work from this time. Most of the common help consisted of colored union men. Their rates per hour were extremely high, and they worked very slowly. It was found necessary to make new labor classifications. By this means the men were satisfied to work for less pay and were practically doing the same work as before. Instead of calling them brick-carriers, however, we called them brick wheelers and instead of hod-carriers, simply wheelers.

Another method was instituted that might well be mentioned here. Union men were not allowed to work with non-union men, but common laborers were permitted to unload brick cars; so instead of unloading the brick from the car and placing them in a separate pile, the men were instructed to unload the brick directly upon the scaffolds. Thus a saving was made both as to time and cost as the material was handled but once from the car to the bricklayers.

BRICK-WHEELERS UNLOADING CARS.

The railroad track was about 75 feet from the north wall of the building, thus the scheme for unloading brick heretofore mentioned could be used to advantage.

The cost of unloading divided by the number of brick expressed in thousands gives the cost per thousand brick.

Date		Unloading Car			N ^o of Brick Unloaded.	Daily Cost		Total Cost.	
		Number	Initial	N ^o of Brick.					
Aug.	15				20000	10	70		
"	16				15000	9	45		
"	22				12000	6	65		
"	23				11000	5	40		
"	24				9000	4	00		
"	25				9800	5	00		
"	29				25000	12	39		
"	30				33000	17	15		
"	31				21500	10	00		
Sep.	1				22000	10	54		
				Total	178300			\$91	28

The cost to unload brick was $\frac{91.25}{178300} = 51$ cents per thousand.

HOD CARRIERS AND MORTAR MEN.

In this account there is included the cost of mixing the mortar, the carrying of the hod, and the shifting of the scaffolds from one place to another. This divided by the number of brick layed gives the cost of hod carriers and mortar men per thousand brick.

This class of laborers was paid 25 and 35 cts. per hour.

Date		Description of Work	N ^o of Brick Laid	Daily Cost		Total Cost	
Aug	22	Carrying the hod and mixing mortar	7916	14	00		
"	23	"	11250	13	95		
"	24	"	16460	12	20		
"	25	"	13000	12	45		
"	26	"	14485	15	55		
"	27	"	6465	13	09		
"	29	"	17000	21	50		
"	30	"	11280	27	15		
"	31	"	14400	30	40		
Sep.	1	"	14000	19	57		
			126250			\$179	86

The total number of brick laid was 126250, and the total cost of mortar men and hod carriers was \$179.80; therefore the cost per thousand brick laid was $\frac{179.80}{126250} = \1.46

BRICKLAYERS.

The cost of bricklayers, owing to the scarcity of men, was very high; besides, the best men usually work with regular contractors and were not available. In this particular case, the men we could get were what are known as "shifters", that is, they work only a short time at one place. As a result of their constant moving about, they are not in condition to work much of the time.

Keeping these things in mind and making allowances for varying conditions, the writer believes that the cost of bricklayers as shown in this table is very nearly correct.

These figures were obtained by taking daily measurements and noting the number of brick laid per day.

The bricklayers were paid 62 1/2 cts. per hour.

The bricklayer foreman received 70 cts. per hour.

Date		Description of Work	Brick Laid	Daily Cost	Total Cost
Aug.	22	Bricklayers worked on S. Wall of W. Build.	7916	45 60	
	23	" " "	11250	59 08	
	24	" " "	16460	80 95	
	25	" " W. "	13000	81 63	
	26	" " "	14485	60 60	
	27	" " " E. build.	6465	41 00	
	29	" " W. W "	17000	56 60	
	30	" " " "	11280	60 43	
	31	" " " "	14400	60 60	
Sep.	1	" " " "	14000	74 65	
Total.			126256		\$621 04

The actual cost of labor per thousand brick laid in the wall was $\frac{621.04}{126256} = \4.91 . From this table it can be seen that the average man will lay about 1000 brick per day.

ADMINISTRATION.

This, the writer believes, depends greatly upon the executive ability of the men in charge, and the conditions existing on the particular job. In general, it is expected that the field administration should amount to about 5% of the pay roll. In this particular case the cost of administration was a little less than 5%.

To aid in checking the cost of the various parts of the work it is wise to make out a Construction Distribution as shown below.

CONSTRUCTION DISTRIBUTION.

Items.	Amount.
Administration	\$ 2950
Engineer	2500.
Framing Dimension Timber	26819.
Erecting " "	14171.
Mill Work.	3340.
Cast Iron and Steel Work.	5493.
Bricklayers	55632.
Force Account, this is charged to some outside party.	175.
Total	\$109180.

REPORTS.

The superintendent submitted weekly reports stating the progress of the work, and at the end of each month an estimate was sent in giving a more detailed description of the work and of material on hand.

It is good practice to take pictures during the progress of construction, say about every fortnight, to show the actual conditions existing on the job. Fig. (3) is a picture taken about two weeks after work began.

Contractors usually carry accident insurance. The insurance company charges a certain per cent of the pay roll, for the risk involved. The risk varies according to the kind of work and not according to the total pay-roll; and therefore the pay-roll sheet ought to show the various items of expense to facilitate the computation of the amount of insurance to be paid. For example, there is little or no risk connected with the administration, while there is considerable risk in connection with the work of the riggers. If an insurance distribution is made something like that shown on *this* page____, it will enable the contractor to secure a lower cost of insurance than if he paid a flat rate on the entire pay roll. For example, the pay roll for the week ending September 1st, 1904 was \$1091.80 and the insurance distribution report is shown as follows:

INSURANCE DISTRIBUTION.

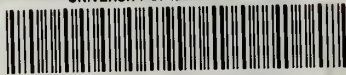
Account.	Amount.
Administration	\$ 2950.
Watchman	750.
Engineer	2500.
Carpenters	22530.
Riggers	7265.
Laborers	21620.
Bricklayers	38855.
Hod Carriers	12710.
Total	\$109180

*Fig. 3*





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